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BIOLOGICAL EVALUATION

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Mountain Pine Beetle on Laramie Peak
Medicine Bow National Forests, Wyoming

1988

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INTRODUCTION

Forest personnel on Laramie Peak District informed TFP&CFM of large areas of tree mortality on the Laramie Peak District. In response to this concern, Forest Pest Management Entomologists Curtis O'Neil and Ken Lister conducted an aerial observation flight of the affected area on May 23, 1988, and confirmed that a drastic increase in tree mortality had occurred over the area since the previous flight in 1986. The cause of the extensive mortality is the Mountain pine beetle, Dendroctonus ponderosae Hopk.

The Mountain pine beetle (MPB) has been noticeably present in the Laramie Peak District on the Medicine Bow National Forest for the past 10 years. The principle hosts, ponderosa pine Pinus ponderosa Laws and lodgepole pine Pinus contorta Doug., have endured low to moderate levels of beetle outbreak, which were occurring mainly south of Laramie Peak from the Pine Mountain area north to Bear Head Mountain prior to 1984. In August 1984, over 6,000 trees on 4,900 acres were killed. In 1987, over 34,000 dead trees on 6,700 acres were mapped. The MPB activity had increased further to the north to include areas of high visibility from Laramie Peak eastward.

The purpose of this evaluation is to:

1. Determine whether MPB populations are increasing or decreasing.

2. Risk rate ponderosa pine to determine susceptibility to MPB.

3. Determine the distribution of MPB within stands.

The United States Forest Service, Wyoming Division of Forestry, and the Bureau of Land Management held joint meetings to determine areas of major concern for management to reduce tree mortality to MPB. Each agency pointed out specific areas where MPB are present and of concern (See Map-Figure 1). The areas were selected for further evaluation of the beetle outbreak.

VICINITY MAP

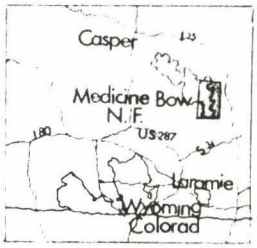
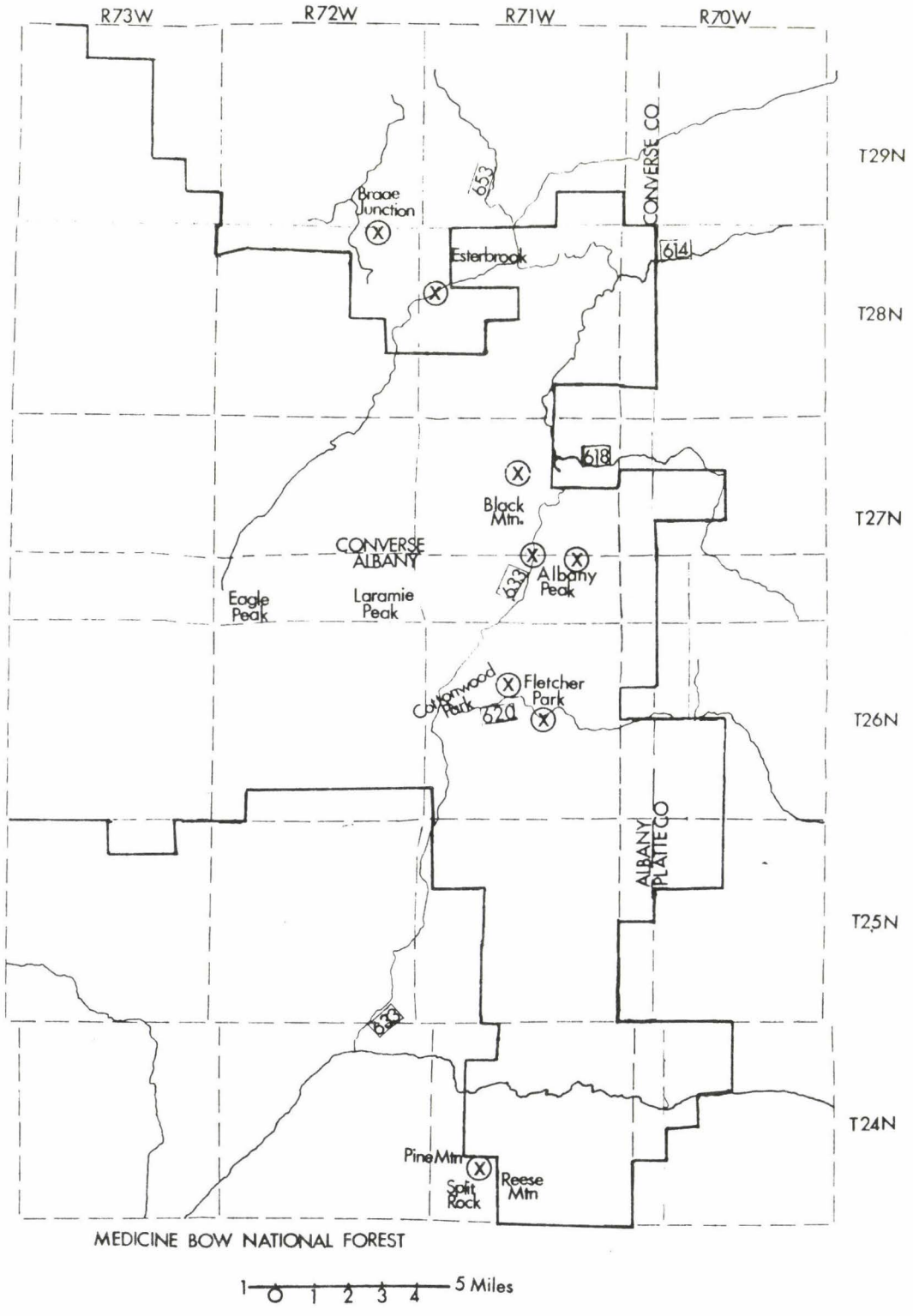


Figure 1. General area of increased MPB mortality and survey plot locations (X).



METHODS

During the week of June 20, Curtis O'Neil, Entomologist, collected beetle population data using the sequential sampling scheme developed by
F. B. Knight in 1960. Two 6 x 6 inch bark samples were removed from each tree at 5' to 7' high on the bole. The following information was taken from each bark section:

-Total number of live MPB by life stage.

-Total inches of adult MPB broad gallery.

-Presence or absence of MPB predators, parasites, and woodborers.

Ten bark samples were taken at each plot rather than sampling until population trends were determined for each plot.

From June 28 through July 1, 1988, variable plot (10 BAF) surveys were conducted in stands where beetle brood plots were established and in additional areas. The plots were located within clusters of beetle-infested trees, and in adjacent uninfested plots spaced at 2.5 chain intervals from infested plots for a distance up to 10 chains. The following information was collected from each variable plot:

-Diameter of all trees > 4.4" dbh

-Basal Area

-Number of trees/acre

-MPB-attacked trees by year of attack

Variable plot information was then used to risk rate the stands using the guide by Stevens and McCambridge, 1980.

RESULTS

Mountain pine beetle populations are summarized in Table 1. The cumulative number of beetle brood, 769 beetles in 80 samples, is indicative of a static to increasing beetle population. Predators/parasites of MPB were present in 33 percent of the samples, and woodborers were present in 21 percent.

Results from variable plots are provided on Table 2. Average basal area dropped from 176 square feet in 1985 to 65 square feet in 1988. Trees per acre dropped from 292 to 129 during this time period. In comparison, uninfested plot averages are currently 127 BA and 225 trees per acre. This indicates enough green trees remain, particularly in currently uninfested areas, to further support the beetle populations. Nearly all the stands surveyed are in the high risk category of susceptibility to MPB. Risk rating results by unit are provided in Table 2.

The Pine Mountain area is unique from the other areas surveyed; therefore, it was analyzed separately. Ponderosa Pine has been depleted to the point that variable plots consisting of uninfested ponderosa could not be readily found. See Table 3.

Table 1 Summary of Sequential Samples of mountain pine beetle populations from 6x6 inch sections of bark.

Medicine Bow National Forest

Plot	Number of Samples	Cumulative No. Samples	Total Brood per Plot	Cumulative Total Brood	Population Trend		
					Down	Static *	Up
Albany Peak(F)	12		117			X	
W.Albany Peak(F)	12	24	151	268		X	
Gray Rocks North(S)	10	34	82	350		X	
Drylake (B)	12	46	144	494		X	
Fletcher Park(F)	10	56	65	559		X	
Fletcher Park(S)	12	68	140	699		X	
Gray Rocks (S)	10	78	54	753		X	
Harris Park(F)	2	80	16	769		X	

(F) - Forest Service Land
(S) - State Land
(B) - BLM Land

*Results indicate to continue sampling as inconclusive in each case, both by individual areas and combined areas. However, beetle counts were closer to increasing than decreasing.

silvicultural practice is the most reliable strategy for reducing beetle outbreaks in the long run.

Although the risk rating results in this evaluation indicate high risk for the areas surveyed, there are parts of stands that vary in beetle susceptibility due primarily to tree density variations.

A risk rating system for MPB in ponderosa pine is provided in Appendix B. In the guide, Stevens discusses the importance of defining a stand when rating susceptibility to beetle outbreaks.

ALTERNATIVES

Several methods to reduce mortality to mountain pine beetle are available. Some tactics reduce beetle populations directly, and others work directly at reducing the beetle host material while increasing the vitality of the residual trees and helping prevent them from perpetuating beetle outbreaks, or at least to increase survival when outbreaks occur. Still other well-proven tactics such as prevention with chemical application are useful. Each method has limitations depending on stand conditions, location, tree values, and other variables. In order to manage large areas of beetle outbreak, control tactics are more effective when administered in various combinations. Together the alternatives support the concept of integrated pest management.

Alternative 1: Silvicultural Treatment - Harvest green infested trees and additional trees to open the stand canopy for better growing conditions. Removal of beetle-infested trees and additional trees will reduce future losses to beetle outbreaks, particularly when reduced to approximately 100 healthy well- spaced trees per acre, preferably below 80 basal area.

Alternative 2: Prompt Utilization - Fell green infested trees and older dead trees; remove them from the site for mill processing.

Alternative 3: Mechanical Control - Fell and buck infested trees and treat them by burning, peeling the bark, or chipping the beetle infested logs.

Alternative 4: Semiochemicals - Designate areas where trees can be sacrificed and used as bait along with MPB pheromones. Once the infestation has been concentrated in a stand, prompt treatment should be carried out. Semiochemical use appears to be gaining more acceptance as a practical tool for bark beetle management. It is possible that some stands in this evaluation area will qualify for pilot testing.

Alternative 5: Chemical Control - Fell, limb, and buck infested green trees into manageable logs, and apply lindane insecticide to kill the beetles prior to the next flight period.

Alternative 6: Individual Tree Protection - Spray the bole of valuable trees to approximately 30' high or where diameter of bole is about 5" at top. Several pesticide formulations are currently registered for this use. It is most practical for use in and around campgrounds, private homes, etc., where individual tree values are high. Individual trees can be protected for two years with a single spray application.

RECOMMENDATION

Land management agencies and land owners should cooperatively develop a vegetation management scheme to reduce the impact of the mountain pine beetle epidemic. Through an integrated pest management approach, other resource management objectives and opportunities, i.e., fuel reduction, wildlife habitat improvement, timber sales etc. can be met. The management scheme should be based on a strategy that includes a land classification system that incorporates risk to mountain pine beetle, land accessibility, and tree value. Appendix A provides an overview of the decision tree analysis concept developed for addressing pest problems within the Region. We strongly encourage its use and incorporation into the planning and action phases being developed for resource management on the Laramie Peak District.

APPENDIX A

A Revised Strategy

Mountain pine beetle (Dendroctonus ponderosae Hopk.) is indigenous to lodgepole pine (Pinus contorta Dougl.), ponderosa pine (P. ponderosa Laws.), and limber pine (P. flexilis James) in Wyoming. Tree mortality caused by this insect will continue to occur where there are suitable host tree species. The key to managing the insect-host complex is to reduce tree mortality to some acceptable level. An acceptable level of tree mortality will vary in accordance with the goals and objectives of the land manager for specific land areas. Therefore, management strategies must be developed which consider a wide range of management objectives and land use values.

Using decision analysis, a procedure was developed to match management strategy to a land classification system (Freeling and Seaver, 1980). The procedure first develops a land classification system based on the following criteria:

1. Risk to mountain pine beetle (MPB) infestation.
2. Land accessibility (and/or operability).
3. Tree value.

The eight land classification categories developed were:

A. Moderate to high MPB risk
   Accessible
   High individual tree value

B. Moderate to high MPB risk
   Accessible
   Low individual tree value

C. Moderate to high MPB risk
   Inaccessible
   High individual tree value

D. Moderate to high MPB risk
   Inaccessible
   Low individual tree value

E. Low risk to MPB
   Accessible
   High individual tree value

F. Low risk to MPB
Accessible
Low individual tree value

G. Low risk to MPB
Inaccessible
High individual tree value

H. Low risk to MPB
Inaccessible
Low individual tree value

The criteria used to develop the land classification system are qualitative. However, each can be quantified. Since this is a dynamic classification scheme, it will need to be updated to keep pace with tree growth (risk), improved harvesting technology, and changing land use values.

Mountain Pine Beetle Risk - To risk rate Ponderosa pine, the scheme of Stevens (Appendix B) is suggested.

Accessibility - Accessibility implies operability. Both accessibility and operability vary with the management strategy selected and the equipment available to implement the strategy. As an example, slopes in excess of 40 percent may be inoperable to conventional logging equipment but operable for high lead system; or operable for chemical pesticide application.

Tree Value - Value systems are highly variable and often difficult to quantify. The goals and objectives established for an area determine the value system(s) to be used (i.e., recreation and aesthetics, wildlife habitat, a value affected by tree density, and quality, and land use). Effects of the mountain pine beetle may enhance or detract from that value. The objective is to minimize the loss of the resource value from mountain pine beetle through the application of one or more strategies. For mountain pine beetle there are three preventive strategies:

-Thinning of stands
-Preventative spraying
-Favoring tree species other than the host species

and one suppression strategy:

-Direct control-actions taken to reduce the population immediately.

Inherent in these management strategies is their applicability, or more properly, their nonapplicability on some land classifications. As an example, direct chemical treatment of low risk, low value trees over large inaccessible areas would be inefficient economically and therefore inappropriate.

Five major premises were developed using decision analysis (Freeling and Seaver, 1980):

1. All host type, regardless of ownership, can be stratified into land classification units.

2. Mountain pine beetle cannot be controlled by any method over extensive areas of land.

3. Management and control of MPB is viable in restricted areas of timber type having relatively high value.

4. The ideal strategy for managing mountain pine beetle is to intensively manage the host type, thereby preventing outbreaks from occurring.

5. Prevention is a viable strategy only in moderate to high susceptible stands or in low susceptible stands which will be in moderate to high susceptible condition in the near future.

Failure to recognize these premises will lead to failure for any long range management of mountain pine beetle.

Management opportunities identified in the decision analysis process (Freeling and Seaver, 1980) were:

1. Incorporate into Forest plans management prescriptions for the major insects and diseases which cause tree damage in the Region.

2. Involve State and local governments to a greater degree in future planning efforts.

3. In cooperation with Federal, state, and local governments and private landowners, implement a management program to prevent and suppress the mountain pine beetle on all lands in land classifications A, B, C, and E, using the following recommended strategies.

   Land Classification A - On developed recreation areas where mountain pine beetle is present, the preferred strategy is to suppress the insect by harvesting infested trees before beetle flight. On developed recreation areas where an epidemic has run its course, the preferred strategy is to do nothing. If an epidemic has not yet occurred, thinning is recommended. This reduces the susceptibility of the area to mountain pine beetle.

On type A areas other than developed recreation sites, the preferred suppression strategy is thinning for prevention, or harvesting of infested trees. In areas where the beetle is already epidemic, the preferred strategy is dependent upon tree value and recreation values. If the recreational value is greater than about six times the stumpage value (acre basis), then suppression is best. With lower recreation values, however, thinning is the preferred strategy. In areas where the beetle is either not present, or is inactive, thinning is preferred, as thinning may prevent beetle epidemics. In particular, immediate thinning is much preferred to waiting for an epidemic to start and then thin. Thorough analysis of the benefits and costs of the various tactics in relation to the value of the management objectives will aid in development of the preferred approach to suppression in a given situation.

Land Classification B - In these areas, a thinning program is the preferred strategy. This is due largely to the beneficial silvicultural effects and reduced detrimental recreation effects.

Land Classification C - In these areas where thinning is impractical due to constraints on accessibility and operability, suppression by chemical means is considered the best strategy under epidemic conditions. However, this strategy is only marginally superior to doing nothing and accepting the losses.

Land Classification E - On these low MPB susceptibility areas, harvesting infested trees is the preferred strategy. Because these are high value lands, this strategy is effective in reducing the impacts on scenic, recreational and real estate value.

In summary, the greatest benefit appears to be from thinning programs in those highly susceptible areas where beetles are not present, but there is also some net benefit from continuing with suppression efforts in these higher value areas where beetles are present.

4. On land classification areas D, F, G, and H, allow the mountain pine beetle to run its course.

5. Initiate and maintain a continuous program of unified management on all lands.

APPENDIX B

Risk Rating Guide for Mountain Pine Beetle in Black Hills Ponderosa Pine

Robert E. Stevens, William F. McCambridge, and Carleton B. Edminster[1]

Average tree diameter, stand density, and stand structure are key elements used in the rating. Single-storied stands are most susceptible to heavy mountain pine beetle damage. Risk increases with d.b.h., reaching a maximum when trees are 12 inches d.b.h. and larger. During buildup of an outbreak, denser stands within a given mean diameter are more susceptible to invasion.

Keywords: Insect control, Scolytidae, bark beetles, *Dendroctonus ponderosae*, *Pinus ponderosa*.

Ponderosa pine stands in the Black Hills of South Dakota and Wyoming vary in their susceptibility to mountain pine beetle (MPB) outbreaks. This rating guide is designed to help land managers recognize stand conditions that are associated with low, medium, and high susceptibility (or risk) to MPB-caused losses. Similar guides have been prepared for other beetle-host associations (Amman et al. 1977, Lorio 1978, Safranyik et al. 1974, Schmid and Frye 1976). Using these guides, the land manager can compare stands and assign priority for thinning or other kinds of actions to those having the greatest risk of beetle-caused damage.

This rating guide is based on observations that provide insight into the kinds of stand conditions associated with MPB outbreaks (Sartwell and Stevens 1975) and the authors' experience with ponderosa pine and MPB in the Black Hills and elsewhere.

Three stand characteristics affect susceptibility to beetle attack: (1) stand structure, (2) average d.b.h. of the ponderosa pine component, and (3) stand density as expressed by average basal area per acre. Diameter growth rates, discussed by Sartwell and Stevens (1975), are closely correlated with stand density and are not considered separately.

[1]*Entomologists and Mensurationist, respectively, Rocky Mountain Forest and Range Experiment Station. Headquarters at Fort Collins in cooperation with Colorado State University.*

Also, species composition is not included because relatively few acres of ponderosa pine are found in mixture with aspen, birch, or spruce, the other important tree species in the Black Hills.

This guide is designed to be applied to forest stands only; it will not work if applied to other kinds of units. A stand must be consistent in species composition, site quality, structure, tree density, and past treatment. Note that size (area) is not a stand characteristic.

Stand Structure

The single-storied ponderosa pine stand is most susceptible to heavy MPB damage. It is most likely to become damaged first and also to suffer heavier losses (i.e., larger groups of killed trees and more of them). An arbitrary risk rating of 3 (table 1) has been assigned to such stands. Next in susceptibility is the two-storied stand, where attention is focused on the characteristics of the overstory trees. As tree size and density increase, these stands increase in susceptibility to approximate that of the even-aged stand. An overall risk of 2 is assigned to two-storied stands.

The multistoried stand is too small a component of the Black Hills forest to include in risk rating. As more acreage comes under management, such stands will presumably become a significant portion of the forest and can then be rated as experience with them develops.

Table 1. --MPB risk classes for Black Hills ponderosa pine

	Risk classes		
	1 = low	2 = moderate	3 = high
Stand structure	—	2-storied	single-storied
Average stand d.b.h. (inches)	<6	6-10	>10
Stand density (square feet per acre)	<80	80-150	>150

Mean Stand Diameter

As d.b.h. increases, risk of beetle outbreak also tends to increase, reaching a maximum when trees are around 12 inches d.b.h. and larger. Consequently, as mean stand diameter increases (i.e., the d.b.h. of the tree of average basal area), the risk of that stand being destroyed also increases. The risk is high (3), moderate (2), or low (1) when mean stand diameter, in trees at least 5 inches d.b.h., is more than 10 inches, 6 to 10 inches, or less than 6 inches, respectively. It is difficult to predict how much more susceptible a stand having a mean d.b.h. of 8 inches is than one having a mean d.b.h. of 12 inches or more. However, heavily damaged stands in the Black Hills are usually in the 10- to 12-inch d.b.h. range.

Stand Density as Basal Area Per Acre

During the years a mountain pine beetle outbreak is building to its maximum destructive capability, the more dense the ponderosa pine stand is within a given mean diameter, the more susceptible it will be to severe losses. At maximum outbreak levels, this pattern is less evident because beetles must attack trees in a variety of conditions.

Stand density is arbitrarily ranked high (3), moderate (2), or low (1) when the basal area of ponderosa pine stems—in trees greater than 5 inches d.b.h.—is greater than 150 square feet per acre, 80 to 150 square feet per acre, or less than 80 square feet per acre.

Using the Risk Plan

The user evaluates the characteristics of a stand and assigns to it the appropriate risk values shown in table 1.

First, determine whether the stand is single- or two-storied. Second, estimate stand density in trees 5 inches and larger and average stand d.b.h. Select risk values from table 1 and calculate risk by multiplying these together. Risk is then as follows:

Stand risk value	Risk rating
2-6	Low
8-12	Moderate
18-27	High

For example, consider a single-storied stand (risk 3) with a basal area of 180 square feet per acre (risk 3) and a mean d.b.h. of 11.2 inches (risk 3). The relative risk of such a stand is 27 (3 x 3 x 3). Such a stand is the most susceptible to MPB attack. If the average d.b.h. of the stand is 8 inches, the risk is 18 (3 x 3 x 2)—still high, but closer to moderate. The least susceptible stand, a two-storied thin stand of small trees, would rate 2 x 1 x 1, or at the bottom of the low risk category.

Other Factors

The maximum size area to be given a single rating will probably be the main difficulty users experience with this plan. Some judgment in interpreting the guidelines in particular areas is necessary.

The key, as Schmid and Frye (1976) discuss in their risk-rating plan for spruce beetle, is to properly distinguish a stand. If the forest area in question does not fit the definition of a stand, particularly with respect to the three characteristics in this guide, ratings will probably be inaccurate.

Consider, for example, a 100-acre unit of ponderosa pine forest. Stand density over the entire unit may average 60 square feet per acre. If we used this average, it would work into our rating plan as "low risk." But if the overall area were made up of several 5- to 10-acre stands with densities approximately 200 square feet per acre and only widely scattered trees over the remainder, "low risk" would not properly categorize the entire area. The thickets are individual stands and would properly be classed "high risk."

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